DEPARTMENT OF THE NAVY
OFFICE OF THE ASSISTANT SECRETARY
(SHIPBUILDING AND LOGISTICS)
WASHINGTON, D.C.

BEST MANUFACTURING PRACTICES

REPORT OF SURVEY CONDUCTED AT

IBM CORPORATION
FEDERAL SYSTEMS DIVISION
OWEGO, NY

OCTOBER 1986

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The purpose of the Best Manufacturing Practices (BMP) survey conducted at this facility was to identify their best practices, review manufacturing problems, and document the results. The intent is to extend the use of progressive management techniques as well as high technology equipment and processes throughout the U.S. industrial base. The actual exchange of detailed data will be between contractors at their discretion. A company point of contact is listed in the report

The intent of the BMP program is to use this documentation as the initial step in a voluntary technology sharing process among the industry.

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CONDUCTED AT

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FEDERAL SYSTEMS DIVISION

OWEGO, NY

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I. INTRODUCTION

A. Scope

The purpose of the Best Manufacturing Practices (BMP) Review conducted at IBM Corporation, Federal Systems Division was to identify best practices, review manufacturing problems and document the results. The intent is to extend the use of high technology equipment and processes throughout industry. The ultimate goal is to strengthen the U.S. industrial base, solve manufacturing problems, improve quality and reliability, and reduce the cost of defense systems.

To accomplish this, a team of Navy engineers reviewed IBM's Federal Systems Division (FSD) to identify the most advanced manufacturing processes and techniques used in that facility. Manufacturing problems that had the potential of being industry wide problems were also reviewed and documented for further investigation in future BMP reviews. Demonstrated industry wide problems will be submitted to the Navy's Electronics Manufacturing Productivity Facility for investigation of alternatives to resolve the problem.

The review was conducted at FSD in Owego, New York on 7-10 October 1986 by a team of Navy personnel identified on page 2 of this report. FSD is primarily engaged in the design, development, and production of sophisticated electronic information processing systems for aircraft, ground stations, space vehicles, and ships.

Based on the results of BMP reviews, a baseline is being established from which a data base will be developed to track best practices and manufacturing problems. The information gathered will be available for dissemination through an easily accessible central computer. The actual exchange of detailed data will be between contractors at their discretion.

The results of this review should not be used to rate IBM Federal Systems Division among other defense electronics contractors. A contractor's willingness to participate in the BMP program and the results of a survey have no bearing on one contractor's performance over another's. The documentation in this report and other BMP reports is not intended to be all inclusive of a contractor's best practices or problems. Only selected nonproprietary practices are reviewed and documented by the BMP survey team.

B. Review Process

This review was performed under the general survey plan guidelines established by The Department of the Navy. The review concentrated on three major functional areas; management, design engineering and manufacturing. IBM FSD identified potential best practices and potential industry wide problems. These practices and problems, and other areas of interest identified were discussed, reviewed and documented for dissemination throughout the U.S. industrial base.

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II. SUMMARY

The Best Manufacturing Practices Survey Team evaluated management, design and, manufacturing functions. Areas reviewed included IBM's management policies and strategy, design and production engineering, material procurement, receiving inspection, facilities, integrated testing, quality assurance, material handling, inventory control, computer aided manufacturing, and vendor selection and control. The team also discussed manufacturing problems such as component solderability, vendor quality control, and component standardization.

The format for this survey consisted of formal briefings and discussions on best practices and problems. Time was spent on the factory floor reviewing practices, processes and equipment. In-depth discussions were conducted with FSD personnel to document, in detail, some of the practices and problems identified.

Some unique policies in IBM's management strategy were reviewed. They included a full employment practice which has been successfully maintained for the past forty years. This has required some flexibility and inconvenience at times, but has paid off in work force continuity and loyalty. Communication and quality improvement efforts are also strong features of IBM's management. Much of this philosophy has filtered down to their suppliers. To better control potential supplier problems, IBM has developed and implemented several automated management systems that provide real-time paperless contact and control of their vendor base.

A top down approach is used to better standardize hardware design. Guidelines have been developed and reviews put in place to smooth the transition to production. These reviews often include front end involvement with operations and manufacturing engineering. A variety of automated design tools are used to interface and translate between design process areas. Simulations and analysis are key elements of the process. To better manage all of the elements of design, IBM has developed a division-wide, computer networked Engineering Information Data System. Updated design data is maintained for retrieval and generation of bills of material, part number data, parts selection, cost estimating, and engineering change notices.

IBM Federal Systems Division is the prime contractor to the Navy for the development of a Circuit Card Assembly and Processing System (CCAPS). This project has lead to the development of state-of-the-art hardware and software for the flexible production of defense circuit card assemblies. Five subsystems have been developed and incorporated into FSD's manufacturing operation. A flatpack

prepper, robot discrete tinner, laser part marker, DIP inserter, and robot flatpack mounter are operating with substantial increases in productivity, reduced defects/ rework, and yields in the upper 90% range. These subsystems were developed in a modular concept for individual or collective adaptation in other defense contractors' facilities.

Many of the manufacturing problems identified and discussed were similar to those discussed at other plants; i.e., component solderability and vendor quality control. IBM has component quality problems related to their high utilization of automated equipment. It is related to the lack of standard flatpack mechanical and carrier requirements. Since IBM is leading the industry in automated assembly of flatpacks, the problem has not reached that much of industry. Automated prepping and assembly equipment built to flatpack standards and used several years ago is often not easily adaptable to changing flatpack mechanical features and new style carriers. This is viewed as a potential problem to all of industry as they evolve to automated assembly with flatpacks. IBM recommends development of an industry standard for flatpack mechanical characteristics and carriers.

The best manufacturing practices and problems identified at FSD will be evaluated and reviewed by the Navy team during future BMP surveys. Those practices identified as being among the best in the electronics industry will be documented in a central data base for dissemination throughout the industrial base. The industry wide problems will be investigated by the Navy in an effort to develop alternatives for their resolution.

III. BEST PRACTICES

The practices listed in this section are those identified by the Navy BMP survey team as having the potential of being among the best in the electronics industry. This judgment is based on experience from previous BMP surveys and expertise gained by team members through years of working relationships with industry.

A. Management

RESPECT FOR THE INDIVIDUAL

Respect for the Individual is one of IBM's three major principles of operation. This principle is defined as "caring about the dignity and rights of every person in the organization, not just when it is convenient to do so."

Aside from the obvious components of such a principle (i.e., equal opportunity, promotion and merit pay, corporate responsibility, benefits, etc.), there are several components that are particularly worth noting.

Full Employment Practice: IBM has a no layoff practice backed up by 40 years of history. Workload peaks and valleys are smoothed out by subcontracting, overtime, voluntary transfers, interplant transfers of workload, and retirement incentives. This practice, while inconvenient at times, ensures continuity and loyalty of the work force.

Open Communications: There are several effective mechanisms in place for establishing a two-way communication vehicle. The "Open Door Policy" enables every employee to approach anyone in the company (including the Chairman) about a problem. Typically, employees will use this vehicle to talk to a second line manager about a problem that cannot be resolved with the first line supervisor. Conversely, every second line manager is required to schedule an annual voluntary "Skip Level Interview" with every employee two levels below him. These interviews are confidential and are used by the managers to evaluate employee morale and to rectify any developing problem.

The "Speak Up" program is another formalized communication vehicle. Special Speak Up forms are available at the bulletin boards. Employees may use these forms, or a designated telephone number, to voice their opinions on any matter. These forms are sent to the General Manager's staff after the employee's name and identification has been removed by the "speak up office." The matters are then investigated and replies prepared on a confidential basis.

The "Employee Opinion Survey," which will be discussed later, is still another vehicle that complements the others as part of an integrated communication policy.

Human Resource Management: A key indicator of the importance that IBM places on human resource management is in the appraisal criteria for its managers. Human resource management counts for at least 30% of a manager's overall appraisal. In addition, a manager's overall rating cannot be higher than his human resources management rating. Obviously, this makes every manager very cognizant of this issue.

EXCELLENCE PLUS PROGRAM

The Excellence Plus Program is an IBM Federal Systems Division Quality Improvement Program initiated in 1982 based on the premise that the opportunity exists for every process in business to be improved. The four key components of the program are management commitment, a site-wide network of employee Quality Improvement Teams (QIT's) committed to working towards improving the quality of their products and services, quality education and awareness, and quality improvement recognition. The goal of the program is to eliminate business and product defects. Excellence Plus has a Program Manager and an Executive Level Quality Council which is chaired by the Vice President/General Manager. The council meets monthly to discuss QIT efforts, site quality measurement, and program planning.

The program achieves its objectives through QIT's which address specific quality problems. The problems are either selected by the teams or assigned by management. The teams meet about one hour per week and follow formal program procedures. The team is dissolved after the problem is resolved, unless it goes into a monitoring mode. Performance measurements charts are posted in the applicable shop areas showing status of the problem. These charts were very evident throughout the manufacturing areas. QIT recognition is in the form of a personal thank you or a letter, and nonmonetary awards presented at a breakfast, luncheon, or off-site dinner (for site level awards).

QUALITY FOCUS ON THE BUSINESS PROCESS

Federal Systems Division has implemented an IBM corporate-wide program to reduce costs and improve efficiency in an often neglected area, the business process. The program is entitled "Quality Focus on the Business Process." It is dedicated to implementing a logical, disciplined process of conducting all aspects of the business. This program deals with administrative/business processes and is not applied to hardware functions. The improvement process uses a four step process to increase business quality. These steps are: define, measure, stabilize, and improve the process.

A corporate Quality Instruction provides the mandate for this program. Quality Focus on the Business Process has been very successful in reducing business costs.

EMPLOYEE OPINION SURVEY

IBM Federal Systems Division invites its employees to participate in an Employee Opinion Survey, which is conducted every 18-24 months. Although participation in the survey is voluntary, the employee participation rate is in the 90% range. These surveys are conducted by the corporation and include approximately 100 questions. Typical questions deal with job and facility satisfaction, career development, and management relations. Anonymity is guaranteed the employees who participate in the survey. The results of the survey are used by all tiers of management to attempt to better working conditions, improve personnel relationships, etc. The results of subsequent surveys are compared to those of previous surveys in an effort to recognize trends, measure improvements, etc. The conduct and subsequent follow-up of the employee opinion survey by IBM is an excellent employee relations activity.

MANAGEMENT PERSONNEL EXCHANGE TRAINING

It was evident to the BMP survey team that IBM has a policy in place for cross training management personnel. Several instances were presented of managers being rotated from one functional group to another.

This policy has obvious benefits. It tends to tear down organizational barriers and leads to better informed decisions by these managers. In the long run, such a policy leads to a more well rounded and effective management team.

COMPUTER AUTOMATED SUBCONTRACT SYSTEM

Computer automation is playing a major role in the management of manufacturing operations. Federal Systems Division has developed three computer applications to improve the administration of subcontracts. Each application is discussed below.

The Computer Automated Subcontract System (CASS) is a tool for subcontract administrators and buyers to use in writing procurement documents by interfacing with the computer. CASS is an interactive system which allows the user to select standard procurement clauses and use them in preparing final documents. The text of the selected standard clauses is displayed on an IBM 327X terminal, added to, modified, edited, etc. to produce a final document displayed on the terminal or printed in final form at the user location. CASS eliminates preparation of subcontract procurement documents from scratch and rewriting or retyping of standard clauses.

The Supplier Support Subsystem (S^3) provides for terminal-to-terminal communications between the subcontractor and the IBM subcontract administrator. S^3 improves communications by eliminating the delays associated with sending paper between sites.

Federal Systems Division also uses personal computers for developing major negotiation positions. They save man-hours, increase accuracy, and provide for quicker turnaround and ease of making changes, corrections, and offers during the negotiation process.

VENDOR QUALITY MONITORING SYSTEM

IBM Federal Systems Division (FSD) has a computerized vendor quality monitoring system in place that is very effective. FSD has several resident quality control representatives located at vendor facilities at locations all around the country. Each of these "residents" has a computer by which he can communicate instantly with his manager at the Owego site. The timeliness of this system was witnessed while conducting the BMP survey. In a period of approximately 40 minutes, the Acquisition Quality Control manager received three messages from "residents" located in such distant locations as Salt Lake City, UT; Dallas, TX; and Teterboro, NJ. Each message dealt with a "real-time" vendor quality situation. The information and response capability offered by this system is probably the most efficient and speedy of any similar system.

VENDOR RATING SYSTEM

Vendor source selection usually includes a "point" rating system of 1 through 100. A typical rating structure is:

1 - 50	Unacceptable
51 - 60	Barely Acceptable
61 - 80	Acceptable
81 - 100	Highly Acceptable

IBM Federal Systems Division (FSD) has recently adopted a U.S. Air Force color code system for rating vendors. This system removes any opinionated ratings in a point system range; i.e., 82 vs. 86, and assigns the vendor to a color code according to capability. Vendor ratings are then further defined by the assignment of a "risk factor" code. These codes are:

Color			Risk Factor		
Red	-	Unacceptable	H	-	High
Yellow	-	Marginal	M	-	Medium
Green	-	Acceptable	L	-	Low
Blue	-	Highly Acceptable			

FSD is very satisfied with the color code rating system and feels it is an improvement over the point system.

B. Design

DESIGN PRACTICES

IBM is in the process of developing a set of Structured Design Guidebooks. These guidebooks will cover all aspects of the development process as they apply to the development engineering disciplines. It is a formal framework for a disciplined design approach as well as an excellent training curriculum for junior engineers. The guidebook presents an overall approach from the individual design perspective and contains a set of guidelines and checklists which tie the many company detailed guidelines and policy statements together. The following guidebooks will be available.

a. Program overview
b. Logic design
c. Mechanical design
d. Analog design
e. Diagnostic software
f. Microprogramming
g. Power supply design

DIGITAL TEST TECHNOLOGY

IBM Owego is developing a prototype system for automatic test generation and robotic diagnostics for digital and memory subassembly using signature analysis.

Signature analysis is a very attractive test methodology for LSI, VLSI and VHSIC device technology and for transient failures. Signature analysis (1) is independent of device complexity, (2) permits shop replaceable assembly, test, and troubleshooting at operational performance levels, and (3) offers a high degree of fault (transient as well as fixed) detections and isolation, and (4) is relatively easy to automate.

MANUFACTURING TEST EQUIPMENT

In an effort to reduce test system cost, use off-the-shelf/modular equipment, improve operator interface, provide comprehensive testing capability, and integrate test systems, IBM has been designing test systems utilizing personal computers (PC). This PC based test equipment supports manufacture of processor products and unit level testing.

ENGINEERING INFORMATION DATA SYSTEM

IBM developed the Engineering Information Data System (EIDS) to supplement CAD/CAM (non-graphic documentation) and provide design, component, manufacturing, and other engineering a tool for obtaining information on parts. It is also used by program offices for configuration management. Through terminals (approximately 500 in use), the different engineering disciplines can input and retrieve design data. Each data file has a responsible group to maintain current updated files (i.e., part cost is the responsibility of cost engineering). As new programs come on-line, new data is added, old data updated, errors corrected in a standard format, and new requirements/capabilities added. Its current configurations provide the following data bases.

a. View/generate bill of materials
b. Part number data
c. "Where used" for components or assemblies
d. Parts selection system
e. Preliminary cost estimating for designers
f. Write engineering release/change notices

As an engineering tool, the system appeared to be widely used. The files provide current and accurate data and establish a common baseline for all the engineering disciplines; data becomes a permanent retrievable record. The system automates engineering notebooks and maintains configuration and design release control.

A new EIDS feature allows for paperless approval of change notices which reduces cycle time.

c. *Manufacturing*

PART VERIFICATION TEST PROGRAM

IBM Owego is in the process of increasing their capability to perform 100%, full temperature, functional testing on all incoming DIP's, IC's, memories, and flat-

packs. Equipment has been procured and programs are being generated to automatically test these components.

Test engineers have devised test methods that utilize standard programs (portions of previously written programs) in order to reduce programming time in half. They have also modified test equipment handling fixtures to enhance component feed throughput.

Although these testing practices are in common use and employ available off-the-shelf equipment/technology, IBM is applying the best practices available to meet these test requirements.

AUTOMATION TECHNOLOGY

IBM Owego is in the early development phase of the Remote Query Support Terminal (REQUEST) Program. Basically, REQUEST will utilize a computer network system for the following applications:

a. Collect labor information from operators (time on jobs).
b. Provide ready access to assembly drawings and documents.
c. Manufacturing routings.
d. Manufacturing document creation/access.
e. Reject notice information collection.
f. Work instructions.

The REQUEST system will utilize PC's at operator work stations for accessibility to the operators. With the REQUEST system, IBM will consolidate all the documents and procedures used on the manufacturing floor and ultimately obtain the ideal paperless factory. Benefits which could be derived include:

a. Reduction of paper in the plant.
b. More rapid/timely availability and quality of information.
c. Improved productivity and capacity.
d. Improved quality of work.

The first of two phases (labor claiming) will be operational during 1987. Phase II operation will begin in third quarter of 1987.

CONTINUOUS FLOW MANUFACTURING

Continuous Flow Manufacturing (CFM) is a manufacturing system that supports the concept of scheduling and producing only what is needed, when it is needed. The CFM concept is similar to Just-In-Time (JIT). CFM at IBM is an ongoing examination and improvement effort which requires

integration of all elements of the manufacturing process to reduce processing cycle time, inventory, work in process (WIP), resources per unit, material handling, scrap, rework, etc. while improving employee morale and product reliability.

CFM has been implemented in the multilayer circuit card area. The following improvements speak for themselves. (Data is for February 1985 to February 1986.)

a. Work-in-process has been reduced from 10,000 to 4,000 panels.
b. The average WIP age was reduced from 40 to 20 days.
c. Cycle time: (65 day/order reduced to 33 day/order; 1988 goal is 20 days/order).
d. Asset turnovers have doubled.
e. Less space is required.
f. Operation hours have been reduced for rework and manufacturing.
g. Employees are more involved; ownership appears at lower levels.
h. Many problems are brought to the surface which were previously hidden by volume.
i. Finally, and more importantly, there is less pressure to work numbers and more emphasis to improve quality.

CIRCUIT CARD ASSEMBLY AND PROCESSING SYSTEM

The Circuit Card Assembly and Processing System (CCAPS) is a unique attempt by IBM to develop a truly flexible manufacturing cell for Circuit Card Assemblies (CCA's). The program is funded by the Navy Manufacturing Technology Program and is designed for automated operation in an environment that features a large number of different CCA's and small lot sizes. The intent is to develop and demonstrate an integrated modular manufacturing system that is transportable to other DOD contractors. The emphasis will be on improved quality, productivity, and turn around time.

The CCAPS manufacturing philosophy is based on the following:

a. Automation for quality and productivity.
b. Continuous flow (just-in-time) manufacturing.
c. Pull scheduling.
d. 15 day release to stock cycle.
e. One piece orders.
f. Zero setup goal.
g. Smooth order release.
h. Engineering changes worked outside production line.
i. Complete orders to manufacturing.

CCAPS consists of four basic elements. The two integrating elements are the Computer Automated Management Segment (CAMS) and the Material Transfer System. The actual value added is created in the receiving interface and preparation module and in the card assembly and test module.

It is important to note that while flexible manufacturing systems for machined parts are in place or under development at several firms, CCAPS will be the first such system for CCA's. The technology will be made available to other firms who may choose to implement the entire system or any number of individual modules.

The program is scheduled to be completed and demonstrated in 1989-1990.

FLATPACK PREPPING SYSTEM

To handle the relatively large amount of flatpacks used in in-house assembly, IBM Owego designed their own flatpack prepping system. NETCO (Northeastern Tool Company) built the two working models used at IBM.

The flatpack prepper automatically tins and forms flatpacks. This includes removing them from the carriers, pre-straightening the leads, fluxing, solder dipping, checking for lead straightness using a vision system, forming and trimming, then vision scanning again prior to auto unload of the flatpack back into the carriers. The system processes up to 424 flatpacks per hour. The alternative to this system is hand forming of the flatpacks and hand trimming, which is a slower and less efficient process. IBM boasts a 4.6:1 boost in productivity and a 98% yield using the auto prepping system over hand processing.

The effort IBM has put forth in designing their own automatic flatpack prepper demonstrates a commitment to advanced manufacturing.

ROBOT DISCRETE TINNER

The robotic discrete component tinning process was developed as a subsystem of the Navy's Manufacturing Technology CCAPS Project. Its purpose is to solder coat discrete component leads for a variety of configurations. The system cleans, solder coats, packages, and labels parts.

Slightly less than 2,000 parts can be processed each hour. Productivity improvement is a staggering 11:1. The overall yield is in excess of 99% including scrap and rework.

ROBOT FLATPACK MOUNTING SYSTEM

To handle the volume of flatpack assembly, IBM Owego designed and built a robotic flatpack mounting system. There are currently two in use at the IBM FSD Owego facility.

Flatpacks from the flatpack prepper are loaded onto carriers and placed in tubes. The tubes are then loaded into inventory racks on the mounting system. The flatpack mounter uses an IBM robot to pick up the desired flatpack from the inventory rack and places it at one of three mounting stations. The system can handle 39 unique part numbers and can process three unique or identical circuit card assemblies (CCA's) at the same time. The CCA's are hand loaded onto fixtures at the mounting stations. A head assembly then swings over the board and uses a vision system to line up the pads for the flatpack to be placed. The head then picks up the flatpack dropped off by the robot and uses a vision system to verify lead straightness and to center the flatpack to fit its pad pattern. The flatpack is then placed and solder reflowed into place using two hot contact knives. The system is data driven. It can be programmed to place selective parts on any configuration CCA. The development of this system reflects IBM's commitment towards advanced manufacturing.

QUALITY TEARDOWN PROGRAM

IBM Owego relies rather heavily on outside procurement to supply various electronic subassemblies for their programs. When IBM writes a contract with an outside source, certain quality measures are written into the contract. For major electronic subassemblies, some contract requirements that IBM places on the vendor include:

a. Provisions for source audits by IBM quality personnel.
b. Provisions for production line audits by IBM quality personnel.
c. Requirements for production reliability acceptance testing (component functionality, vibration, and thermal stress).
d. Provisions for at least one teardown audit at the vendor's facility.

A teardown audit is a nondestructive disassembly and evaluation of a product prior to acceptance by the customer. The burden of the actual teardown is placed on the vendor, in that he is responsible for the actual disassembly of the item. An IBM team of quality personnel is present to observe the teardown and to do the actual testing and evaluation. In the audit, the IBM audit crew follows a standard check list, and with its own

instruments, tests various components and inspects for workmanship defects.

The performance of at least one teardown of a subassembly is a condition of the purchasing contract that must be met prior to IBM taking delivery of the item(s). Actual hardware selected for teardown is done on an impromptu/random basis. IBM lets the vendor decide at which point during the manufacture of the subassembly the teardown will occur. IBM prefers that it be done during the production reliability acceptance testing cycle.

After the teardown, the IBM team informally debriefs the vendor's personnel. This is followed up by a formal letter of the findings.

IBM uses the teardown audit as a tool to insure (1) that the hardware configuration is in place according to the specifications, (2) the vendor is following any previously established corrective action, and (3) the workmanship of the product is acceptable.

Additionally, electronic subassemblies manufactured within IBM Owego or FSD facilities are subject to similar teardown audits by IBM quality personnel. This serves as an internal check and balance. DCAS personnel observe these internal teardowns.

Results of teardowns are disseminated formally in a report. This report is forwarded to IBM Owego upper management including the General Manager.

IV. PROBLEM AREAS

The problems discussed below were identified by IBM FSD as having the potential of being industry wide problems. The BMP survey team will collect more data on these problems from other contractors and government agencies. This data will be reviewed and those manufacturing problems considered to have an industry wide impact will be forwarded to the Electronics Manufacturing Productivity Facility, China Lake, California for research and resolution. Some of the problem areas may lead to the establishment of a government/industry ad hoc group to evaluate the concern and propose alternative solutions.

COMPONENT SOLDERABILITY

Attempts have been made by most defense electronics prime contractors to get solderable components from their suppliers. Improvements have been noted by some, but the problem is still there. Most primes have gone to 100% pretinning of vendor supplied parts to assure good solderability during assembly.

The BMP survey team has noted that most primes just have not had much success in getting vendors to supply good solderable components. Each company surveyed has identified component quality/solderability as a real problem. The defense electronics industry does not get any support from the commercial industry because they do not have the same specification requirements. Without that support, it has been difficult to apply any real pressure on the vendor base because the defense sector represents such a small fraction of the total business to the vendor.

Establishment of a defense electronics industry committee to address this problem has been discussed by several primes. This subject will be discussed at the Industry/Navy BMP workshop scheduled for May 1987 in China Lake, CA.

FLATPACK STANDARDS

IBM is having difficulty automating their flatpack operation because there are no standards for flatpack carriers or carrier tubes. When IBM began using flatpacks and designed their automated equipment, they represented the major part of the market. As other manufacturers started using flatpacks, the suppliers began to change to different carriers and tubes for cost and other reasons. This presented a problem for IBM since their automated equipment was designed to a specific carrier and tube. There is no leverage to require a supplier to ship in a specific carrier or tube because there is no standard specification.

To further complicate the problem for IBM, the flatpack itself has broad mechanical tolerances. Some otherwise acceptable flatpacks are just not adaptable to IBM's automated equipment making manual prepping and mounting mandatory. IBM believes tighter front end controls need to be placed on mechanical features to make them suitable for automation. Just because a vendor ships an Approved Parts List flatpack, that does not mean it will be compatible with an automated process/equipment.

PRODUCIBILITY MEASUREMENT

IBM has established a producibility assurance program to enhance their competitiveness, hardware design structure, quality focus, and overall performance. Many companies have established similar programs. What is missing and appears to be a common problem in the electronics industry is a system to measure producibility improvements. The benefits of such a program are evident but actual quantitative payoff cannot be determined.

DOD, Army, Navy, and Air Force all have producibility guidelines to assist industry in improving their disciplines and practices. Some educational institutes and private firms have researched producibility measurement criteria but have not agreed on a system. IBM believes this is an area that should be addressed by the industry rather than each company attacking the problem on their own.

V. CONCLUSIONS

After reviewing IBM Federal Systems Division's best practices, it was apparent that much attention is given to resource management, material, people, etc. The corporate policy of Respect for the Individual is among the best witnessed by the BMP survey team. Even though FSD is a defense oriented division which is often subjected to a fluctuating production schedule, they have managed to maintain full employment. This in itself builds employee loyalty and a motivation to strive to do better. This factor coupled with an open communication policy, quality improvement programs, and employee opinion surveys has helped FSD build a stable work force that takes pride in their job and the company.

Management of the vendor base is a critical element of FSD's operation. They realize the importance of putting high quality parts into their product. Even with this emphasis on suppliers, problems will occur. To control the problems before they get too far out of hand, IBM has implemented a computer network between FSD and their major suppliers. This capability not only highlights problems in real-time, but provides the mechanism to resolve them without the normal delays of sending letters and documentation through the mail. Most problems are identified and resolved in a real-time environment. The system also provides the information needed to rate the vendors, an important consideration when procurements are being placed.

Automation of data is also a major concern in the engineering arena. An Engineering Information Data System was designed at IBM Owego and implemented throughout the division to provide a wide range of capabilities. The system can be queried to display a bill of materials, part number data, part selection criteria, cost estimating, and engineering change notices. Approximately 500 computer terminals have access capability to the system, which is maintained in a current and accurate status by different responsible engineering groups. The system appeared to be widely used by the engineering community.

Being the Navy's prime contractor for development of a flexible Circuit Card Assembly and Processing System (CCAPS), IBM has designed and incorporated state-of-the-art equipment into their manufacturing process. Much of FSD's electronics has evolved to circuit card assemblies using flatpacks. Development of CCAPS subsystems such as the flatpack prepper, robotic discrete tinner, laser part marker, DIP inserter, and robotic flatpack mounter have substantially improved productivity and reduced defects, rework and cost. These subsystems were designed to operate as individual modules or as a complete system in any defense electronics facility. The CCAPS program is scheduled to be completed and demonstrated in the 1989-1990 timeframe.

To complete the improvement cycle, IBM conducts part verification tests on incoming material and quality tear-downs of completed products. This gives them reasonable assurance that the parts going into the product being built are good and remain that way through assembly and test. The teardown also helps identify workmanship defects that may not be apparent during the test cycle. The results of both part verification tests and the teardowns are used to make changes/improvements in suppliers, supplier quality, and manufacturing procedures.

Most of IBM's manufacturing problems are similar to those of the rest of the defense electronics industry (component solderability, vendor quality control, etc). As we collect more data on the common problems, a baseline will be established from which action can be taken to resolve some of the more critical ones. The Navy and industry will have an opportunity to discuss a course of action for these concerns at the BMP workshop scheduled for May 1987 at the Electronics Manufacturing Productivity Facility in China Lake, California.